

## **Abstract: Groundwater Sampling Techniques for Site Characterization and Hydrocarbon Risk Calculations Technical Background Document and Recommendations**

Groundwater sampling in contaminated source areas can sometimes incorporate non-aqueous phase liquid (NAPL or free product) in the water samples. Impacts of NAPL in water samples include reported water concentrations that may be well above the true dissolved-phase concentrations that can lead to inaccurate and/or incomplete understanding of site conditions. The purpose of this document is to help make responsible parties, regulators, and consultants aware of the NAPL incorporation issue when collecting and interpreting groundwater sample data; provide examples of the dissolved concentration in equilibrium with the NAPL of several fresh Alaskan fuels; and assess the ability of diffusion bag and filtering to eliminate NAPL and provide groundwater concentrations representative of the true dissolved-phase concentrations.

To help meet these objectives a laboratory demonstration was conducted. The laboratory test results show the following:

- The diffusion bag and carboy jug water samples had almost identical BTEX and VPH concentrations and similar EPH concentrations, indicating that the diffusion bag may be a valuable tool to measure the true dissolved phase BTEX, GRO, and DRO concentrations in NAPL source areas.
- The measured dissolved-phase concentrations from the carboy water and diffusion bags samples correlated well with the calculated dissolved-phase concentrations (based on the NAPL analyses and Raoult's Law).
- The spiked and filtered sample data indicated that filtering removed much, but not all, of the NAPL in the samples.
- The dissolved GRO concentration in equilibrium with gasoline NAPL was about 350 mg/L.
- The dissolved DRO concentrations in equilibrium with JP4, jet A, and diesel fuel ranged from about 1 to 5 mg/L. When field sample results significantly exceed these values for fresh fuel, the sample likely contains NAPL and/or polar, partially degraded fuel hydrocarbons.
- Understanding the solubility of Alaskan fuels can help identify NAPL source areas and assist in interpretation of the groundwater data.

The dissolved-phase concentration data are used to help understand what fuel constituents are most likely to drive risk at fuel hydrocarbon sites by comparing measured and calculated dissolved-phase concentrations with risk-based groundwater ingestion criteria. The results indicate:

1. RRO aromatics and GRO, DRO, and RRO aliphatics cannot partition into groundwater above groundwater ingestion risk-based levels; therefore there are no calculated risk based migration-to-groundwater soil concentrations for these compounds, however, there are regulatory "migration-to-groundwater cleanup levels" in Tables B1 and B2.
2. Given the current default calculation of the migration-to-groundwater route (the variable mixing depth DAF equation), DRO aromatics do not pose a risk through the migration-to-groundwater route; therefore, there is not a calculated migration-to-groundwater soil concentration given the existing DAF calculation, however, there is still a regulatory "migration-to-groundwater cleanup level" in Table B2. Also note that the proposed FMD DAF calculation would yield a soil screening/cleanup level because it accounts for the presence of contaminant in the saturated zone.

3. The fixed mixing depth dilution-attenuation equation provides a better representation of the risk associated with the migration to groundwater route and should be used to better understand the risks posed by NAPL source zones and the benefit of remediation of source zones.

While this paper addresses dissolved phase petroleum hydrocarbons, if NAPL is present it needs to be evaluated and addressed in accordance with applicable guidance and regulations.